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CLASSIFICATION RESTRICTED
SECURITY INFORMATION
CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT NO.

CD NO. --

COUNTRY	USSR	DATE OF INFORMATION	1946
SUBJECT	Scientific - Metals, antimony		
HOW PUBLISHED	Pamphlet	DATE DIST. 24	Mar 1953
WHERE PUBLISHED	Moscow/Leningrad	NO. OF PAGES	4
DATE PUBLISHED	1946		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

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SOURCE Trebovaniya promyshlennosti k kachestvu mineral'nogo syr'ya, Vypusk 17, Sur'ma, All-Union Scientific Research Institute of Raw Materials.

USSR ANTIMONY RESOURCES

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Antimony and its compounds are of great importance in various fields of the national economy. Mainly, alloys with antimony are used in the fabrication of battery grids, bearings, printing type, and certain kinds of ammunition.

More than 160 alloys of antimony with other metals are known in industry. The most essential are lead- and tin-antimony alloys. Their composition and application are given in the following table.

Alloys	Composition in Percent: Antimony	Lead	Tin	Copper	Others	Application or Name of Alloy
Antimony-Lead	5.0-30.0	70.0-94.0	--	--	--	Batteries, acid-resistant products, cable sheathing
	2.4	96.2	--	--	1.0 Zn	Tin foil
Antimony-Copper-Lead	44.5	33.3	--	22.2	--	Durene metal
Antimony-Tin-Lead	7.0-10.0	75.0-89.0	4.0-15.0	--	--	High-melting lead soldiers
	10.5	32.5	48.8	--	--	Engraving plates
	11.70	82.21	6.0	Trace	--	Pattern metal for castings.
Antimony-Tin-Lead-Copper	5.0-30.0	50.0-77.0	2.0-25.0	2.0-4.7	--	Printing type
	1.5-26.0	0.0-86.0	7.0-50.0	0.0-22.0	--	Bearings
	10.0-15.0	0.0-77.0	5.0-86.0	2.3-9.0	--	White metal

25X1A

Chemical compounds of antimony, such as oxides, salts of antimonic acids, sulfides, halides, and certain organic compounds also have industrial application.

Antimony trioxide, Sb_2O_3, is used as a substitute for tin dioxide in white enamels and also serves as an intermediate product for obtaining tartar emetic, antimony trichloride, and antimony fluoride. Lead antimonate is used in the manufacture of oil paints and in the ceramic industry.

Antimony trisulfide exists in two modifications: gray and red. The gray variety, in the form of antimonium crudum, is a basic raw material for obtaining antimony preparations. It is also used in pyrotechnics and in the manufacture of safety matches. The red modification is used in the rubber industry.

Kermesite, $2Sb_2S_3.Sb_2O_3$, finds application as a red pigment. It is exclusively stable against atmospheric agents but very sensitive to the action of acids and alkalies.

Sodium sulfantimonate or Schlippe's salt, $Na_3SbS_4.9H_2O$, is used in photography.

Antimony trichloride, $SbCl_3$, is used for steel bluing, blackening of zinc, and as a mordant. Industry utilizes some other inorganic compounds of antimony, such as antimony oxychloride SbOCl, antimony pentachloride $SbCl_5$, complex fluorides of antimony $4\ SbF_3.NH_4F$, $SbF_3\ (NH_4)_2SO_4$, and others.

The following organic compounds have practical significance: double oxalate of potassium and antimonyl, certain lactates and antimonyl potassium tartrate or tartar emetic, $2(KC_4H_4O_6.SbO)H_2O$, used as mordants in dye manufacture.

Antimony glance or stibnite with 71.38% Sb and 28.62% S is the most essential antimony-containing mineral. A considerable number of antimony minerals are products of stibnite oxidation. The following minerals belong to this group: antimony trioxide, known as senarmontite and valentinite, antimony ocher known as cervantite or yellow antimony ore Sb_2O_4, stibiconite $Sb_2O_4.H_2O$, folgerite $Sb_2O_5.4H_2O$, and stibionite $Sb_2O_5.H_2O$. Red antimony ore or kermesite is a product of incomplete oxidation of antimony glance. In addition, antimony enters into the composition of numerous complex minerals.

The classification of antimony ores and deposits represents considerable difficulties due to the complex character of mineralization. According to De Launay there are seven types of deposits as follows:

1. Quartz lodes containing antimony minerals in association with pyrite and arsenopyrite. In the USSR, certain deposits of the Far East belong to this type: Leninskoye along the Kharga River and Razdol'ninskoye in Krasnoyarsk Kray.

2. Lodes of antimonite with gold. In the USSR this type includes the Kuludzhun, Aramashevskoye, and Ayatskoye deposits in the Ural Mountains, and others.

3. Copper-antimony lodes are characterized by the presence of barite as a rocky matrix. Such an association is represented by the Belousovskoye deposits in Altay Kray and Karabash deposits in the Urals, but Sb concentration in them is very low.

4. Lead-silver-antimony deposits are found in Ridderskoye and Sokol'noye in Altay Kray.

5. Antimony-mercury deposits are in wide occurrence. Sometimes, a mineral complex is made still more complicated by the presence of arsenic minerals, pyrite, hydrocarbons, and graphite. In the USSR, this type is found in Nikitovka, Donbass.

6. Antimony-arsenic-sulfur deposits are comparatively rare in the pure state. There is no information on their occurrence in the USSR.

7. Metasomatic replacement deposits in limestone occur in some areas of Central Asia, such as Kadamdzhay and others.

The classification, developed by De Launay on the basis of deposits occurring outside of the USSR, may be supplemented by two types known only in the USSR.

8. Antimony-fluorite lodes found in Boguchan.

9. Antimony-mercury-fluorite lodes of Khaydarkan in Central Asia, partially exploited. Other deposits in Asiatic and European parts of the USSR are known.

Resources of rich antimony ores in the USSR are limited, and therefore ores with an Sb content of the 1-1.5% order are considered suitable for use. Their beneficiation is achieved by flotation or by the combined method of gravity concentration on tables and flotation. The difficulties of concentrating oxide minerals forced Soviet research organizations, such as Gintsvetmet (State Scientific Research and Production Institute of Nonferrous Metals), Mekhanobr (Scientific Research Institute for Mechanical Processing of Minerals), and Giredmet (State Scientific Research Institute of Rare Metals) to devote special attention to this problem, particularly in connection with processing the ores of the Kadamdzhay deposits where the amount of antimony in oxide form reaches half the total content.

In conformity with Soviet standards, stibnite flotation concentrates must contain at least 33% Sb and maximum 5% moisture.

Grades of commerical antimony were established by GOST1089-41 as follows:

Chemical Composition, in Percent

Antimony Grades	Total Antimony and Lead, Minimum	Share of Lead	Impurities, Maximum					Typical Use
			Copper	Arsenic	Sulfur	Iron	Total	
Su0	99.85	0.7	0.04	0.02	0.1	0.02	0.15	Special Batteries
Su1	99.65	1.0	0.08	0.05	0.1	0.03	0.35	Batteries and lithographic
Su2	99.50	2.0	0.1	0.05	0.1	0.05	0.50	metals
Su3	99.40	0.4	0.2	0.25	0.1	0.15	0.60	Babbits
Su4	98.80	0.8	0.3	0.25	0.4	0.25	1.20	Galvanic stereotypes and solders

Single-metal type antimony ores with average antimony content lower than 1% are not used presently for smelting. Complex ores, permitting selective flotation for obtaining other concentrates in addition to antimony, may be practically utilized even in cases of lower antimony content.

Absence of clay in the ore is essential for the flotation method of beneficiation. Experiments at Giredmet demonstrated that 5-10% clay in ore decreases extraction of antimony from 65 to 35-33% and 20% of clay depresses the amount extracted to 7%.

There was no antimony industry in prerevolutionary Russia. The entire consumption of this metal was covered by import. The first attempt to initiate a domestic industry in the USSR relates to 1929 when the lump ore of the Kadamdzhay deposit was used for smelting antimony trisulfide in the form of "crudum." In 1935, production of lump stibnite concentrate from the Turgay deposit was begun.

Since resources of lump ores in the Soviet Union are limited, methods for obtaining concentrates from poor grade ores were studied simultaneously with the utilization of rich ores.

The first experimental ore-dressing plant was started in 1936 at Kadamdzhay, whose deposits have a great supply of single-mineral ore, mostly disseminated antimony glance. Some lump ore also occurs. In addition to quartz and chalcedony, the ore contains small amounts of fluorite, barite, gypsum, and pyrite. Oxidized minerals occur at all levels of exploitation. Oxidation processes are greatly effective in zones with the fissure state more evident, where water and air had easy access. The amount of oxidized antimony varies from 15 to 55% of total Sb content in the ore.

Second in significance is Turgay deposit in Kazakhstan, discovered in 1929. In addition to fine dissemination of antimony glance, lenticular and pocket inclusions of comparatively pure stebnite occur in this deposit. Resources of the deposit are considerably high.

Razdol'ninskoye deposit in Siberia is the third antimony source exploited in the USSR. The quality of the ore is very high. The ore contains insignificant amounts of arsenic, copper, lead, and a comparatively small addition of oxidized antimony minerals. The deposit was discovered in 1932 and has considerable ore resources.

The entire demand for antimony in the USSR is satisfied by domestic production.

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